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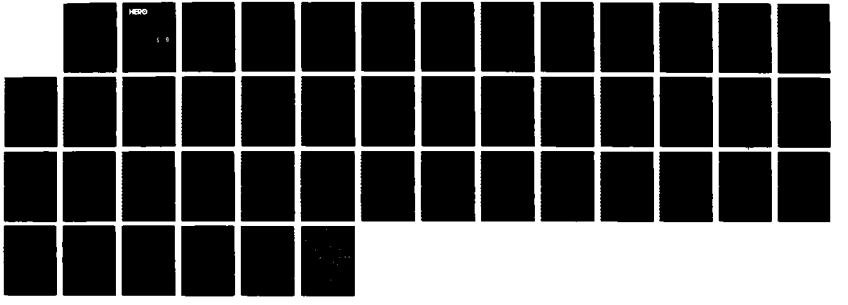

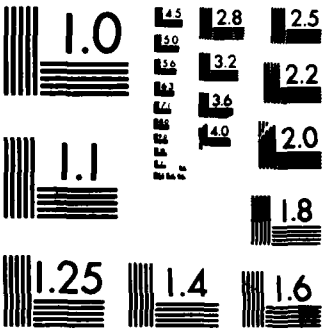

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Historical Evaluation & Research Organization

Report Number 118

CASUALTY ESTIMATES FOR CONTINGENCIES
Vol. I: Report

Final Report

15 November 1985

Prepared for

US Army Concepts Analysis Agency

Bethesda, Maryland

Contract No. MDA903-85-C-0499

A Divison of:
DATA MEMORY SYSTEMS, INC.
8316 Arlington Boulevard
Suite 400
Fairfax, VA 22031
(703) 560-6427

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Trevor N. Dupuy
John R. Brinkerhoff
Brian Bader
C.C. Johnson

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8316 Arlington Blvd.
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Battle casualties	Environmental factors

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Final Report presents the results of contractor efforts on the CEC Study during 15 October 1984-15 November 1985. The report is organized in two volumes. Volume I gives casualty rate matrices developed from data on personnel casualties in minor contingency operations since 1945. The matrices give casualty rates (casualties/1,000/day) for contingency engagements in general and, specifically, with reference to a variety of situational or circumstantial variables. Volume II includes the supporting data base of casualty data developed under Tasks 1 and 2 and analyzed according to the Study Plan developed

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20. ABSTRACT (Continued)

under Task 3.

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INTRODUCTION

The purpose of this study was to compile and analyze data on personnel casualties that have occurred in minor contingency operations since 1945 in order to provide estimates of casualty rates which would be of use to planners of future minor contingency operations.

The original guidance stated that only minor contingency operations which occurred from 1956 to 1985 in which the US or a US ally took part would be addressed. Operations in Europe, Northeast Asia, and Vietnam were excluded specifically. Later the guidance was changed to allow the study to cover the period 1945 to 1985.

The goal of the study was to provide casualty rate matrices in which circumstantial factors and personnel factors would be arrayed to provide specific planning guidance. The circumstantial factors to be addressed included the following: weather; terrain; type of units involved; method of initial entry into the operational area; operational posture; surprise; air superiority; and opposition to initial entry. Personnel categories to be addressed included the following: officer-enlisted breakout; grade; skill; location on battlefield; and combat versus support. The idea was to provide a series of matrices which would forecast the probable casualties for, say, a parachute assault by an airborne unit into a hot climate, rough terrain objective, by grade and skill.

This goal was not achieved, but much useful information has been derived. It has been possible to provide casualty estimates by the circumstantial factors but not by personnel categories.

The primary limitation on achievement of the original goal is the lack of data. It is possible that this limitation can be removed partially by additional research, although finding casualty data is difficult. Data on casualties by personnel categories has been particularly difficult to find.

METHODOLOGY

The approach taken to initiate the research was to compile some sample data, examine it for insights, and then use these insights to obtain additional data in a more structured manner. This approach was necessary because at the start of the study there was little data available on these conflicts and limited understanding of what had taken place since 1945.

Historical Research

The historical research was accomplished mostly by examining secondary sources, as specified by the Sponsor. This allowed review of considerable data within the limitations of time and funding, but it also lowered the quality and specificity of the data that was compiled. One consequence of using secondary source data is that it proved impossible to assemble enough data on the personnel categories of the casualties to make this part of the analysis possible.

Secondary sources are mostly books written about the military operations. The books are written to tell the story,

publicize a personality, or make a point. They are not written to provide data for analysis of casualties. The casualty data included in most of these published accounts is incidental to the main purpose of the account. Strength and casualty data in secondary sources tend to be aggregated, approximate, and inconsistent from one book to another. It is difficult for even a skilled historical researcher to extract consistent data from secondary sources.

Identification of Minor Contingencies

It was necessary at the start to define the kind of military operation which was to be analyzed. The statement of work directed that the data was to be compiled on "minor contingencies," and stated that these were not covered by the OSD Defense Guidance Scenario. However, no definition of this type of military operation was provided. Actually, the term has its base in the strategic plans of the Army, rather than in military operations. Strategic planning documents include the terms major contingency and minor contingency. Major contingencies are wars in Europe, Korea, and the Middle East; and minor contingencies are hostilities of smaller scale elsewhere. Although this leaves a wide range of possibilities, the idea that a minor contingency is a limited operation seemed reasonable. Accordingly, the intial, tentative definition proposed by the HERO team was as follows:

> A minor contingency is a military operation which is limited in scope, geographical area, duration, level of intensity, or combinations of the above.

This definition of minor contingency still allowed a wide range of possibilities for research, from a large scale regional war to a small rescue operation. One of the first things the HERO team had to do, therefore, was to pin down the specific military operations to be examined in detail. This was done by preparing a candidate list of 48 military operations since 1945 and compiling the data on those operations. Once the data was assembled, it was discovered that there was a wide variety of different kinds of operations in that initial sample. This was because the researchers had obtained the easiest data first. The 48 military operations included: raids, insurgencies, counterinsurgencies, peacekeeping operations, shows of force, invasions, interventions, and rescue operations. Some involved combat; others did not. Some lasted one day; others lasted five years. Each military operation appeared to be unique and to defy rational classification.

HERO noticed, however, that there appeared to be a definite distinction between relatively short operations (less than six months) and relatively long operations (over a year). There also appeared to be a definite range of combat intensities represented. Therefore, it was decided to plot the operations according to duration and intensity of combat.

Intensity of combat is a complex phenomenon. All combat is intense to the immediate participants. The HERO team defined four general combat intensity levels, which were applied to the

initial sample. These intensity levels were as follows:

Level 1. Use of force short of sustained violence.

Level 2. Use of force and violence short of sustained hostilities.

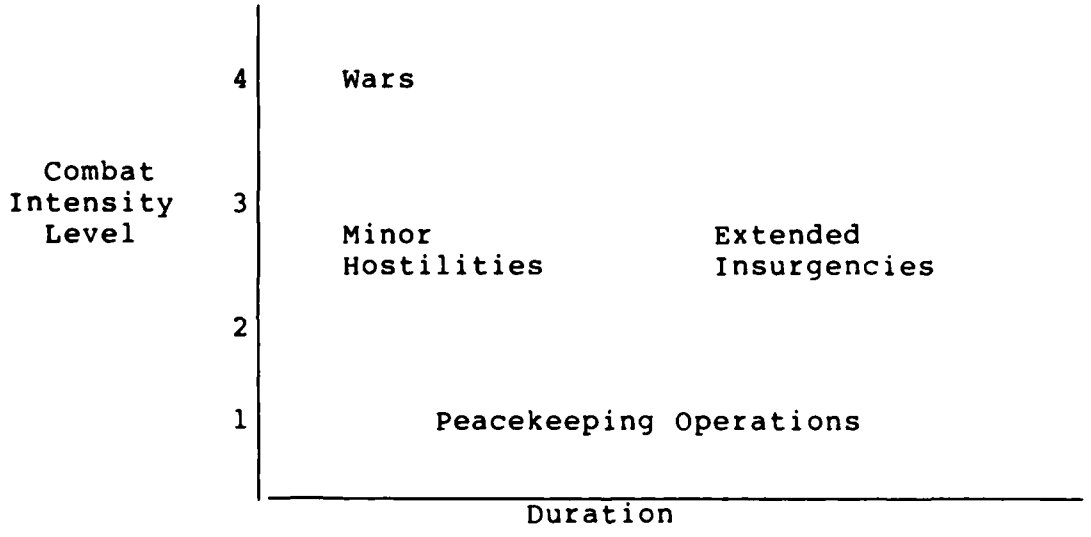
Level 3. Sustained hostilities short of conventional war.

Level 4. Conventional war.

The plot of duration versus intensity for the initial sample of 48 operations revealed some definite groupings which were helpful in defining the kinds of operations which can be counted as minor contingencies. Figure 1 is a schematic diagram of the plotted points. Four groups emerged clearly.

Figure 1

Duration-intensity Plot of Engagement Sample



There was a distinct group of operations without sustained violence or combat; these had various durations. Upon inspection these turned out to be peacekeeping operations and shows of force

in which combat is not intended but violence may occur inadvertently.

There was a small group of operations with high intensity combat, classified as conventional war, and fairly short in duration. These turned out to be wars, including two Arab-Israeli wars, and one India-Pakistan war.

There was a significant group of combat operations involving sustained combat short of conventional war and with long durations, all over one year and many lasting five years or more. These turned out to be insurgencies which were successful enough to last beyond the initial stages. They were called extended insurgencies.

Finally, there was a group of operations clustered at intensity levels 2 and 3 and of relatively short duration. These turned out to be a conglomerate group of different types of operations: raids; interventions; rescue missions; abortive rebellions; and brief (mostly failed) insurgencies. The major characteristic of these operations is that they are constrained in scope, participants, and duration. This group was called minor contingencies.

On this basis, a new working definition of minor contingency was adopted, as follows:

> A minor contingency is a military operation involving armed hostilities (other than a major war) which is limited in duration (less than six months) and area (less than 1,000 kilometers radius of action) and consists of one or more engagements.

Combat Engagement as Unit of Analysis

It was decided to adopt the combat engagement as the unit of analysis. An engagement is one level in the hierarchy of combat shown in Figure 2.

Figure 2

Hierarchy of Combat

Level of Combat	Duration	Units Involved	Common Thread
War	Months-years	National Forces	National Goals
Campaign	Months	Army Groups and Field Armies	Strategic Objectives
Battle	1-3 Weeks	Field Armies and Army Corps	Operational Mission
Engagement	1-5 Days	Divisions-Companies	Tactical Mission
Action	1-24 Hours	Battalions-Squads	Local Objective
Duel	Minutes	Individuals or Single Weapons	Local Objective

The engagement was selected as the unit of analysis because many minor contingencies had more than one engagement, some of them occurring simultaneously in different areas. Also, some contingencies were very short, but others were quite long. Performing the analysis of casualties at the minor contingency level would have masked differences in terrain or posture and would have grouped operations of very different durations.

An engagement is combat between two forces, neither larger than a division nor smaller than a company, in which each has an assigned or perceived mission, which begins when the attacking

force initiates combat and ends when the attacker has accomplished its mission, ceases to try to accomplish the mission, or one or both sides receive significant reinforcements, thus initiating a new engagement. An engagement is often part of a battle. An engagement normally lasts one or two days; it may be as brief as a few hours and is rarely longer than five days.

Definition of Engagement Sample

Having defined the population and unit of analysis, the HERO team proceeded to define the sample of engagements to be analyzed. In order to assure comprehensive coverage of minor contingencies the HERO team made an effort to identify all conflicts which occurred since 1945, and found 290 such conflicts. These were classified as follows:

	Combat Operations
Wars:	38
Minor Contingencies:	105
Extended Insurgencies:	123
Peacekeeping Operations:	24
	290

While 105 minor contingencies were identified, only 72 were eligible for research, because of the various exclusions applied by the Sponsor. Reliable casualty data was available for only 21 of these minor contingencies. At this stage some thought was given to ways of increasing the sample size available for analysis.

Because of the way in which the initial sample had been

assembled, some data had been compiled on engagements that turned out to be from extended insurgencies. Inspection of the data indicated that it was similar to the data from engagements which were part of minor contingencies. In order to make use of this data and increase the sample size, it was decided to combine the extended insurgency engagements with the minor contingency engagements for analytical purposes. This proved acceptable after statistical tests were applied.

HERO compiled strength and casualty data on 21 of the 105 minor contingencies. The 21 minor contingencies disaggregated into 50 minor contingency engagements, and adequate data was found for 47 of these. Two of these engagements which had very high numbers of prisoners taken were excluded, leaving 45 engagements for analysis.

In addition, 31 engagements from extended insurgencies were identified and researched, and adequate data was found for 28 of these.

This gave a total of 73 combat engagements with strength and casualty information.

There were several questions to be answered about this sample of casualty data before the validity of the results could be assessed.

> Is the sample large enough to be significant?
>
> Is the sample representative of the population?
>
> Is it proper to aggregate the 28 extended insurgency engagements with the 45 minor contingency engagements? Do they represent the same population?

Sample Acceptibility

The 45 engagements from minor contingencies represent 14% of the approximately 320 such engagements that are estimated to have occurred since 1945. This is a large enough sample to assume an underlying normal distribution according to the statistical rule of thumb that a sample larger than 30 is a large sample. However, the dispersion of casualty rates is so large that the sample size is sufficient only to provide 90% confidence that the population mean of the Total Battle Casualties (TBC) daily casualty rate is within plus or minus 11 of the sample mean of 27%. This is not very satisfactory.

Recognizing the shortcomings of the sample of 45 minor contingency engagements, the research team compiled data on extended insurgency engagements, using no particular sampling method other than accessibility of data. It was possible to obtain strength and casualty data on 28 engagements from 9 extended insurgencies. These include four engagements on Australian and New Zealand experience in Vietnam but do not include any US experience there.

The sample of 28 extended insurgency engagements represents only 0.7% of the estimated 4,000 such engagements in the population. This sample size is close enough to the rule of thumb of 30 to be considered a large enough sample to apply the normal distribution. The sample size is large enough to provide 90% confidence that the population mean of the TBC daily casualty rate is within plus or minus 5 of the sample mean of 24. This sample size is fairly satisfactory.

Another important question is whether these samples can be considered representative of their populations. This is uncertain. Neither engagement sample was picked by a random process. The process was guided to a great extent by ease of research. The engagements for which data was readily available were done first, more difficult research problems next, and so on until time and money ran out. In addition, constraints were placed on the sample selection, which excluded minor contingencies which occurred in Europe, Northeast Asia, and Vietnam, and which did not include the US or one of its allies as a participant. Thus, the sample of minor contingency engagements cannot be considered representative of the total population, although it may be fairly representative of those minor contingencies in which the armed forces of a sophisticated Western nation engage the armed forces of a less developed Third World nation. The sample of extended insurgency engagements is even less representative, since all of the 28 engagements were taken from only 9 of the 123 extended insurgencies that were identified.

On the whole, neither of the samples is large enough (given the wide range and dispersion of values of daily casualty rates in the population) to provide very satisfactory estimates of population casualty rates. Since the combined sample does provide slightly better results, it was decided to combine the two samples for the analysis.

Figure 3

Comparison of Sample Engagement Data

	Minor Hostility Engagements (MCE)	Extended Insurgency Engagements (EIE)	Combined Sample of Engagments
Number of Engagements	45	28	73
Duration (Days)			
Mean	2.5	12.7	6.2
Standard Deviation	2.7	20.5	13.9
Strength			
Mean	1,621	1,793	1,686
Standard Deviation	2,403	2,179	2,306
Total Battle Casualties			
Mean	62	44	55
Standard Deviation	105	60	90

Combining the Two Samples

In order to determine whether the two engagement samples could be combined, tests were run on four sample statistics: duration, strength, number of total battle casualties, and daily total battle casualty rates. Figure 3 shows the calculated values of the sample mean and standard deviation for three of these statistics. The same values for daily casualty rates are shown in Figure 5.

Results of tests to determine whether it is reasonable to assume that the two samples represent the same population are shown in Figure 4. In these tests the null hypothesis is that the difference of the sample means is zero. If this is true within reasonable confidence intervals, the two samples may be considered to represent the same population.

Figure 4

Comparison of MCE Sample with EIE Sample

STATISTICS:	Duration	Strength	TBC	Daily Rate
MCE (x), N=45				
Mean	2.5	1,621	62	27
Standard Deviation	2.7	2,403	105	44
EIE (y), N=28				
Mean	12.7	1,793	44	24
Standard Deviation	20.5	2,179	60	32
Difference of Sample Means, (x-y)	-10.2	-172	18	3
Standard Deviation of Difference of Sample Means	2.5	554	19.59	9
Number of Standard Deviations from x-y=0	4.08	0.31	0.92	0.33

The results of the tests are stated in terms of standard deviations of the statistic, x-y, the difference of the sample means. For unit strength, total battle casualties, and daily TBC

casualty rate the values of x-y are less than 1 standard deviation from zero, providing reasonably high confidence that the two samples represent the same population for these three characteristics. For duration, however, the value of x-y is over four standard deviations from zero, and this indicates very significant differences in the two samples for this characteristic. This difference in duration is real and will be explained in the analysis section.

Overall, the two samples are considered to be sufficiently alike in their important characteristics to be combined for the purposes of this study.

The combined sample of 73 engagements is of sufficient size to be considered a large sample. Assuming that the population is distributed normally, the sample size is large enough to provide 90% confidence that the population mean of the TBC daily casualty rate is within plus or minus 9 of the sample mean of 26.

Value of the Combined Sample for Prediction

The most important question is the degree to which the combined sample may be considered to be representative of the infinite population of such events, including those events yet to occur. One basis for using historical data for predicting the outcomes or circumstances of future events depends on the extent to which the sample is considered to represent future events. This is difficult to judge. It is concluded that the sample is only marginally valid for this purpose. Extrapolation from past or present patterns and trends into the future requires faith in any case, and so the analysis proceeds.

Defects of the Sample

The sample has some defects which must be taken into account when performing the analysis. In one sense the defects in the sample merely reflect the variety and lack of consistency of this form of combat in reality. Each of the minor contingencies is a unique event with unique circumstances. Generalizations, therefore, are difficult to make.

One problem with the sample is that it does not provide all of the data needed to perform a complete casualty analysis. This is primarily because the research was performed from secondary sources. These secondary sources seldom were written to facilitate an analysis of casualty or any other kind of data. They were written to tell a story, highlight a personality, or push a viewpoint. Thus, the casualty data tends to be incidental to the main purpose of the author and generally is presented in a summary form inconsistently. This leads to many problems in attempting to reconcile conflicting reports and interpolating between the lines.

In addition, the data is not in sufficient detail. It has been possible for almost all of the engagements to distinguish among killed, wounded, and captured/missing in action. In some engagements, however, the data provides only killed, or only total battle casualties, or only wounded. For this reason, six of the original 81 engagements had to be withdrawn from the analysis.

The unique nature of these engagements also causes problems. Two of the engagements involved massive capitulations by the

sophisticated forces of interest. These occurred in the Indian Invasion of Goa and at the Bay of Pigs. Inclusion of these engagements in the analysis distorts the CMIA rates a great deal. It was decided to exclude these two engagements from the final analysis.

Data on the grades, skills, and battlefield location (combat versus support) of the casualties was impossible to obtain on a consistent basis. It was not possible usually to distinguish between officers and enlisted personnel from the secondary sources. Information of this nature can be obtained consistently only from official strength or official medical reports.

Finally, there were very few reported instances of casualties from disease and non-battle injuries. This could mean that these kinds of casualties did not occur in most of these engagements because of the short duration of the operations. It could mean also that these kinds of casualties were not reported in secondary sources. In this case it is possible that official medical records could provide this data. In any case the available data does not permit drawing any conclusions on disease and non-battle casualties.

Exclusion of engagements with incomplete or atypical data from the original sample leaves 73 engagements which can provide a significant amount of information about casualties in minor contingencies.

ANALYSIS OF THE 73 ENGAGEMENT SAMPLE

The analysis of engagement data focussed primarily on daily casualty rates, and the analysis henceforth will deal with those

rates except as noted. A daily casualty rate is defined as follows:

$$\text{Daily Casualty Rate} = \frac{\text{Number of Casualties}}{(\text{Strength in Thousands})(\text{Duration in Days})}$$

The units of a daily casualty rate are losses per thousand troops per day. All daily casualty rates are rounded off to the nearest whole number. All rates are for Total Battle Casualties unless stated otherwise.

In order to indicate the dispersion of the sample and subsample statistics, the standard deviation of the sample has been calculated and is shown for each calculated value of a mean.

Total Sample Daily Casualty Rates

Casualty rates for Total Battle Casualties (TBC), Killed in Action (KIA), Wounded in Action (WIA), and Captured/Missing in Action (CMIA) for the 73 engagement sample are shown in Figure 5. The sample sizes, means, and standard deviations for the casualty rates of the three samples are shown in the figure.

Figure 5

Daily Casualty Rate Statistics of the Engagement Samples

	TBC	KIA	WIA	CMIA
Combined Sample				
N = 73				
Mean	26	6	18	2
Standard Deviation	40	11	30	25
Minor Contingency Engagements				
N = 45				
Mean	27	4	22	1
Standard Deviation	44	8	37	5
Extended Insurgency Engagements				
N = 28				
Mean	24	8	12	4
Standard Deviation	32	15	14	22

In the 73 Engagement sample, 20% of the casualties were KIA; 77% were WIA; and 3% were CMIA. The overall ratio of WIA to KIA is 3.76.

Casualty Rate Versus Unit Strength

The daily casualty rate for total battle casualties was analyzed with respect to unit strength. The findings with respect to unit strength are shown in Figure 6.

Figure 6

Total Battle Casualty Rates by Unit Strength

Unit Strength Class	Number of Engagements N	Mean Daily Casualty Rate %	Standard Deviation
less than 300	14	50	72
301-600	15	32	38
601-1,000	13	23	20
1,001-2,500	17	13	12
over 2,500	14	12	20

The casualty rates in the 73 Engagement Data Base show the same relationship with unit strength as has been experienced in more extended combat in major wars. The smaller the unit, the higher the casualty rate. This relation goes beyond the geometry of exposure to a phenomenon which has been ascribed to "friction in combat." Regardless of the explanation, the effect is real and occurs consistently in all combat.

Casualty Rate Versus Duration

Figure 7 shows the relationship between total battle casualty rates for various classes of engagement duration.

Figure 7

Total Battle Casualty Rates by Engagement Duration

Duration Class (Days)	Number of Engagements N	Mean Daily Casualty Rate %	Standard Deviation
1	37	38	51
2	13	23	21
3 - 5	8	13	9
6 - 10	8	8	11
Over 10	7	1	1

An interesting variation is achieved if a different criterion is applied to assignment of duration for short engagements. The original rule for the sample was to assign a duration of one day for all engagements lasting a part of a day. If a finer screen is used to permit an engagement duration of a half day, the results are somewhat different. For each engagement whose duration is reassigned from one day to a half day, or from two days to one day, the daily casualty rate doubles. Figure 8 shows the difference for the 73 Engagement sample when this reclassification is accomplished.

Figure 8

Total Battle Casualty Rates by Alternative Duration Classes

Duration Class (Days)	Number of Engagements N	Mean Daily Casualty Rate %	Standard Deviation
1/2	36	71	103
1	8	43	31
2	6	31	25
3 - 5	8	13	9
6 - 10	8	8	11
Over 10	7	1	1

For both of these data sets there is a definite relationship between duration and casualty rates. The longer the engagement, the lower the rate. This effect is most pronounced for the engagements longer than five days (which probably should not have been classified as engagements in any case). For an engagement of five days or less, the casualty rates are still higher for a one-day engagement than for a five-day engagement. Whether this means also that rates are higher on the first day of a multi-day engagement than on subsequent days may be inferred but cannot be deduced with confidence from this data sample.

The value of placing a finer screen to develop the alternative duration array is questionable. War functions on a daily basis. The basic reports are daily reports; support activities operate on a daily basis; and planners think in terms of days. The very short engagements which were classified as lasting a half day were all concluded in that same day. As far as medical care or replacements are concerned, it does not matter whether the rates were for a half day or a day. From the planner's viewpoint that engagement lasted a day, even if it was all over from the participant's viewpoint in a few minutes or an hour. Commanders and staffs cannot forecast the length of the engagement in advance and must estimate the number of "days" of medical support and replacements to be provided in any case.

Captured/Missing in Action

Data on CMIA from the 73 Engagement Data Base is important because such data is not normally available in much detail. The overall CMIA proportion of the total casualies is 2.8%, and CMIA were reported in only 9 of the 73 engagements. These nine engagements do not display any definite pattern of influence by any cicumstantial variable. No CMIA were reported for 64 of these engagements.

Two engagements which were omitted from the 73 Engagement Data Base do show large numbers of CMIA. These occurred in the Indian invasion of Goa in 1961 and in the Bay of Pigs invasion, also in 1961. In the Goa invasion, 1,189 CMIA were reported out of total battle casualties of 1,303; this CMIA figure includes the WIA also. At the Bay of Pigs, the CMIA were 4,801 of 4,888

total battle casualties, all out of a strength of 7,195. In both of these cases the CMIA figures resulted from a massive capitulation of one side.

Overall CMIA do not appear to be a major or a consistent factor in these kinds of engagements. This may be partly because CMIA are not reported, or it might be because the less sophisticated force either does not take or does not keep prisoners. A major reason, however, may be that the military forces of the relatively more sophisticated nations engaged in these relatively short combat operations consist of well trained professionals who do not operate in such a way as to incur a large number of prisoners or MIA.

Casualty Rates by Circumstances of Combat

In order to provide casualty rates for various sets of combat circumstances, the 73 engagements were classified according to the eight circumstantial variables shown in Figure 9.

Figure 9

Circumstantial Variables for Casualty Rate Analysis

Terrain
Weather
Surprise
Posture
Air Superiority
Insertion Means
Opposition to Insertion
Organization Type

Total Battle Casualty (TBC) rates were calculated for each of the engagements within each category. The results are presented in Figure 10. Four numbers are given in Figure 10 for the blue forces in each engagement category: N is the number of engagements in a particular class; x is the mean daily total battle casualty rate; s is the standard deviation of the sample, and w/k is the ratio of wounded to killed.

Figure 10

TBC Rates by Circumstantial Variables

Terrain Type	N	x	s	w/k
Flat	17	38	59	3.44
Rolling	16	21	36	3.41
Rugged	21	20	30	3.94
Urban	19	25	32	4.09
Weather Type	**N**	**x**	**s**	**w/k**
Cold	6	30	24	3.54
Temperate	23	36	54	3.66
Hot	44	20	32	3.99
Surprise	**N**	**x**	**s**	**w/k**
Blue Surprise	20	15	19	2.87
No Surprise	43	21	31	4.25
Red Surprise	10	66	73	3.10
Posture	**N**	**x**	**s**	**w/k**
Attack	60	24	41	3.84
Defend	13	33	36	3.55
Air Superiority	**N**	**x**	**s**	**w/k**
Blue Superiority	47	25	40	3.82
No Superiority	26	28	41	3.64
Insertion Means	**N**	**x**	**s**	**w/k**
Overland	51	22	30	3.81
Parachute	9	23	23	2.30
Air Landing	4	6	10	3.00
Helicopter	4	77	112	1.47
Ship	2	6*	-	0
Unknown	3	71	56	6.50
Opposition to Insertion	**N**	**x**	**s**	**w/k**
Opposed	58	27	41	3.84
Unopposed	12	8	11	1.74
Unknown	3	71	56	6.50
Organizational Type	**N**	**x**	**s**	**w/k**
Foot	4	54	57	3.76
Foot, Motor-Mech w/armor	5	19	17	3.53
Motor-Mech w/armor	37	24	45	3.87
Airborne	24	24	32	3.32
Special Operations	3	26	33	1.50

*Less than 1

Daily Total Battle Casualty rates do vary from the mean when related to the eight circumstantial factors. The mean TBC casualty rate for the entire sample is 26 per thousand per day. Casualty rates below 18 or above 34 are considered to vary significantly from the mean. On this basis, the sample shows the following with respect to engagement casualty rates:

o Terrain exercises some slight effect on the casualty rates. The rate for flat terrain is significantly higher than the mean, presumably due to lack of good cover and concealment. The effect of rugged terrain in reducing the casualty rate is large but not necessarily significant.

o Weather has some effect. The mean casualty rate for engagements in hot weather is lower than the mean for the entire sample, although not significantly. This is consistent with experience in major wars. Although the mean for engagements in cold weather is higher than the sample mean, the number of cold weather engagements is too small to permit drawing a definite conclusion from this.

o Surprise has a great effect on casualty rates. When the red forces achieve surprise on blue forces, the blue casualty rate is significantly higher than the mean. This means that forces entering on this kind of military operation must take due precaution against being surprised. When the blue side does achieve surprise, blue casualty rates are significantly lower than the mean. Surprise is a major factor affecting casualty rates in this kind of operation.

o Posture has an effect on casualty rates. The mean casualty rate for blue forces in defense is higher than the mean rate for blue forces in the attack. Three of the engagements were ambushes, and two were red air attacks on blue ground forces in the Falklands in which the more sophisticated forces had very high casualty rates. Only three of the 13 defensive engagements had rates below five. One enduring feature of historical combat is that the defender's casualty rates have been higher than the attacker's casualty rates. This data suggests that the defender's tendency to have higher casualty rates is true of these minor contingency engagements as well.

o Air Superiority was not a factor in blue casualties if blue did or did not have it. There were no engagements in this sample in which red had air superiority, so the impact of effective red air support on blue troops has not been measured.

o Means of Initial Entry into the engagement does show some significant differences in casualty rates. Entry by helicopter leads to significantly higher than average casualty rates, but the mean of this small sample is influenced a great deal by the Mayaguez Incident in which there were numerous casualties from a single helicopter crash. Entry by air landing demonstrates significantly lower than average casualty rates. Although the sample is very small, it is apparent that entry by ship is a particularly safe method.

o Opposition to entry is also a factor. Achieving unopposed entry led to significantly lower casualty rates than entering in the face of active oppostion. This is related to the

desirability of achieving surprise.

o Organization Type does not appear to have an impact on casualty rates. The mean rate of all groups are close to the sample mean rate except for organizations in which foot elements were predominant. Eight of the nine engagements in which foot elements participated took place in 1945 and 1946 in Indochina and Greece, and these had high daily casualty rates. Airborne units were used in 24 engagements which involved 9 parachute assaults and 3 air landings. Airborne units may be used in contingency operations because of their elite status as well as their special qualifications. Most units involved in this kind of operation are motorized or mechanized infantry with some armor, and the results of this analysis suggest that having some form of vehicular mobility is desirable.

The Wounded to Killed Ratio

Another statistic of interest is the ratio of wounded in action to killed in action. The wounded to killed ratio for the entire sample of 73 engagements is 3.76. This is consistent with experience in combat engagements in major wars since 1840. There are some variations with respect to the circumstances of combat which are worthy of note. The variation in the wounded to killed ratio is considered significant for values above 4.50 and below 3.00.

o Terrain does not have significant influence on the wounded to killed ratio. It does appear that the ratio increases slightly with the difficulty of the terrain. The ratio for operations in rugged and urban terrain is higher than the overall

ratio, but not signifilcantly so.

o Weather has no significant impact on the wounded to killed ratio.

o Surprise does have an impact on the wounded to killed ratio. When blue forpces achieve surprise they have a significantly lower wounded to killed ratio than otherwise.

o Posture does not have a significant impact on the wounded to killed ratio.

o Air Superiority does not have a significant impact on the wounded to killed ratio.

o Means of Initial Entry does show some variation in the wounded to killed ratio. Both parachute assault and helicopter entry show significantly lower than average wounded to killed ratios; this means that a much higher proportion of casualties in these kinds of entries are killed outright than is usual.

o Opposition to entry does have impact on the wounded to killed ratio. When entry is unopposed the wounded to killed ratio is significantly smaller than the overall ratio.

o Organizational Type does not have a significant impact on the wounded to killed ratio.

The wounded to killed ratio is affected much less by the circumstances of the combat than is the casualty rate itself. Under most conditions, it can be expected that three to four wounded will occur for each KIA.

Composite Terrain and Weather Casualty Rate Matrix

The tendencies of casualty rates to vary according to the various circumstantial factors are different if the effects of

more than one factor are combined. Unfortunately, the 73 Engagement Data Base does not provide a large enough sample to be able to do this for all the eight factors evaluated. It is possible, however, to combine two factors to produce a composite matrix.

Terrain and weather are two important factors in planning or interpretation of this kind of combat. The terrain and weather matrix combines two of the environmental factors which are determined primarily by the location of the engagement. For an actual or projected engagement the terrain and weather can be predicted very well, and so can the average casualty rates to be expected (provided the engagement sample is a good predictor).

Figure 11 shows the format of the terrain and weather matrix and the number of engagements in each cell. The number of engagements in each cell is not very large, and some cells have too few engagements upon which to base valid conclusions about future rates under similiar circumstances.

Figure 11

Cell Sizes for Terrain and Weather

Composite Casualty Rate Matrix

TERRAIN	WEATHER		
	Hot	Temperate	Cold
Flat	13	4	0
Rolling	12	1	3
Rugged	8	10	3
Urban	11	8	0

The mean daily total battle casualty rates for each combination of terrain and weather are shown in Figure 12.

Figure 12

Mean TBC Rates for Terrain and Weather Composite Matrix

TERRAIN	WEATHER		
	Hot	Temperate	Cold
Flat	26	74 (19)	Ø
Rolling	16	33	36
Rugged	6	30	24
Urban	25	25	Ø

The mean rate for engagements in the Flat-Temperate cell is distorted by a single engagement (the Mayaguez Incident) in which the casualty rate was 235 per thousand per day. Omitting this one engagement produces a mean rate for the cell of 19 per day. Neither value is probably representative of this combination because of the small number of engagements available to compute the values.

Values of the mean TBC rate for other cells appear to be close to the total sample mean rate of 26, except for the Rugged-Hot and Rolling-Hot cells. The low rates of these two cells is consistent with experience in other combat engagements that preoccupation with personal survival and operating in a hostile environment results in lower than average casualty rates for both sides. In these cases the hot climate itself tends to mitigate against aggressive action, and the impact of the rugged terrain lowers the casualty rates further.

This matrix, and others like it for other variables, can be very helpful in planning or interpreting engagements from minor

contingencies or from certain stages of extended insurgencies. The data from the 73 Engagement Data Base is sufficient to prove the validity of the method but insufficient to provide high confidence that the rates experienced are representative of future engagements.

Comparison With World War II Casualty Rates

In order to compare casualty rates for the 73 Engagement Data Base with casualty rates from World War II, two conditions must be fulfilled:

1. The comparison must be made for units of the same approximate size. This is because casualty rates vary according to the strength of the unit.

2. The comparison must be made with casualty rates for engagements rather than for months or years of experience. The US daily casualty rate for World War II was about 10 per day per 1,000 troops. This is much lower than typical engagement casualty rates because it includes many days in which units were not in combat. The daily engagement casualty rate includes only days in which the units were in combat.

Figure 13 shows daily engagement casualty rates for the 73 Engagement Data Base and for four engagements from World War II.* Both sets of rates are arranged by unit size.

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*HERO Report 97, Historical Survey of Casualties in Different Sized Units in Modern Combat, October 1982.

Figure 13

Comparison of WWII and Minor Contingency Casualty Rates

Unit Size	World War II	Minor Contingencies
Company	-	50
Battalion	55	23
Brigade	36	13
Division	21	-

The difference in rates appears at the battalion and brigade level where the two samples overlap. On the basis of this data it appears that daily engagement casualty rates for minor contingencies are from one-third to one-half the equivalent rates experienced in sustained combat in World War II.

This result may be due to several conditions. One primary reason may be that the casualty data for the minor contingencies is for US and similiarly modern, sophisticated forces fighting less sophisticated forces from less developed nations. On this basis, the Combat Effectiveness Value of the blue forces should exceed that of the opposing forces. In general, forces with higher combat effectiveness have fewer casualties that their inferior opponent. During World War II the German troops generally had higher combat effectiveness than American troops.

Another related factor is that the blue forces in these kinds of operations usually did not face the kind of artillery fire that was common during sustained combat in World War II. Most of the weapons on both sides in the minor contingency engagements were small arms, with some tanks and some mortars.

Artillery is a major cause of casualties in modern combat, and its absence would tend to lower battle casualty rates.

Still another possible explanation of the much lower casualty rates for minor contingencies is that many of these operations are short and decisive, without the kind of sustained combat that existed during the more-or-less continuous campaigns and battles of World War II.

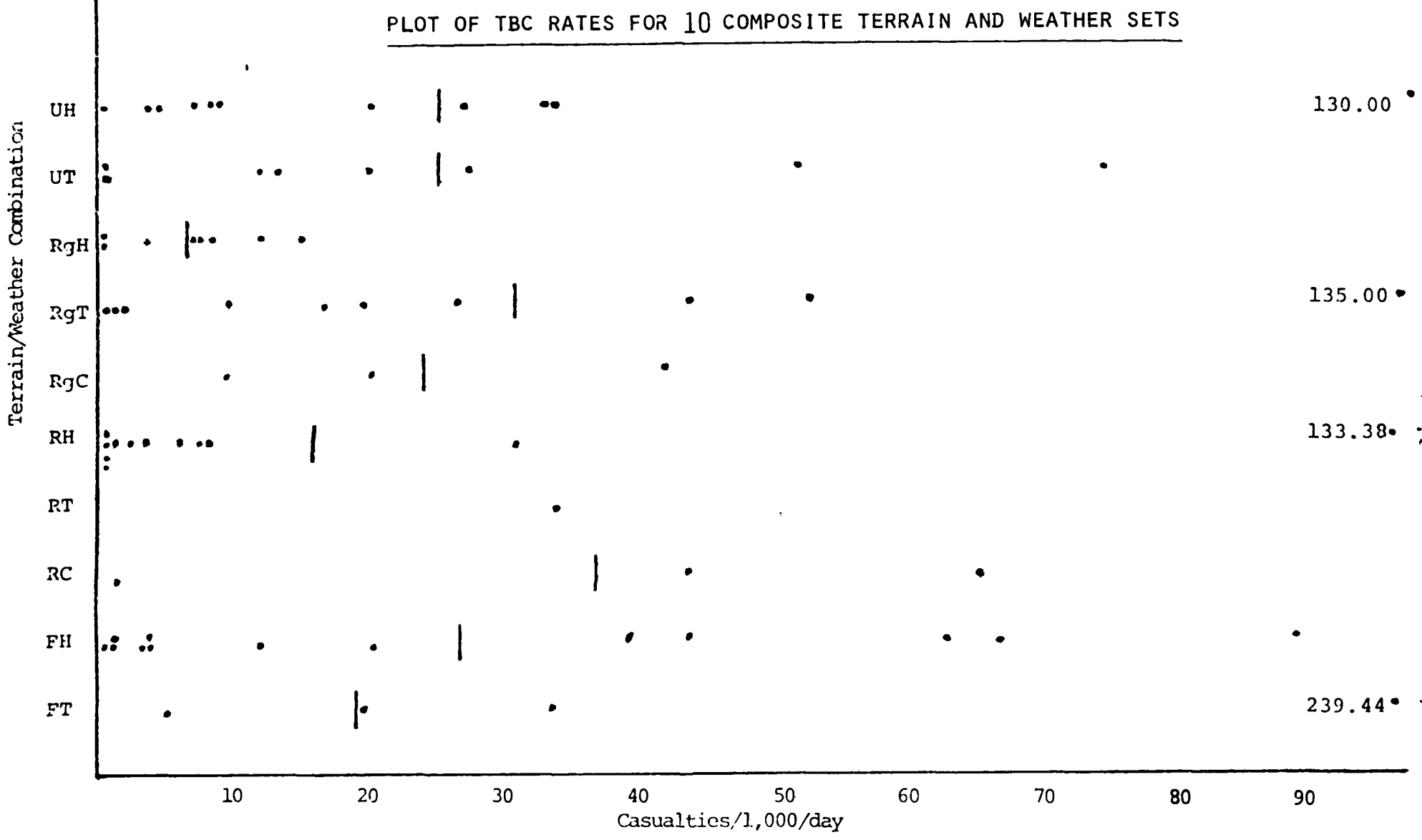
Whatever the explanation, the evidence of this comparison is that daily casualty rates for minor contingencies were much smaller that they were during World War II.

There were no other significant differences between the casualty rates for the minor contingencies and those for World War II. The manner in which the eight circumstantial variables affect the rates appears to be quite similar, and the wounded to killed ratio is about the same for both sets of data.

Comments on the Analysis

The casualty rates of the 73 engagements display a considerable lack of consistency. This is shown by the large standard deviations of the various samples for which means have been computed. There is great dispersion in almost all cases. This reduces the value of the sample mean as the expected value of the mean for the population. Figure 14 is a plot of the rates for the 10 different combinations of terrain and weather for which there were engagements. Figure 14 shows clearly the great dispersion of the daily total battle casualty rates of these engagements.

Figure 14


PLOT OF TBC RATES FOR 10 COMPOSITE TERRAIN AND WEATHER SETS
Terrain/Weather Combination
UH
UT
RgH
RgT
RgC
RH
RT
RC
FH
FT
130.00
135.00
133.38
239.44
10
20
30
40
50
60
70
80
90
Casualties/1,000/day

The inconsistency of the casualty experience in these engagements is demonstrated by the fact that there were no casualties at all in 9 engagements, or 12% of the sample. In addition, there were 11 engagements, or 15%, in which the daily TBC casualty rate was over 50 per thousand per day.

The great variety of conditions, missions, and forces in minor contingency operations means that a wide range of potential casualty rates can be expected. In planning for such operations, therefore, it would be prudent to estimate high casualty rates to be on the safe side.

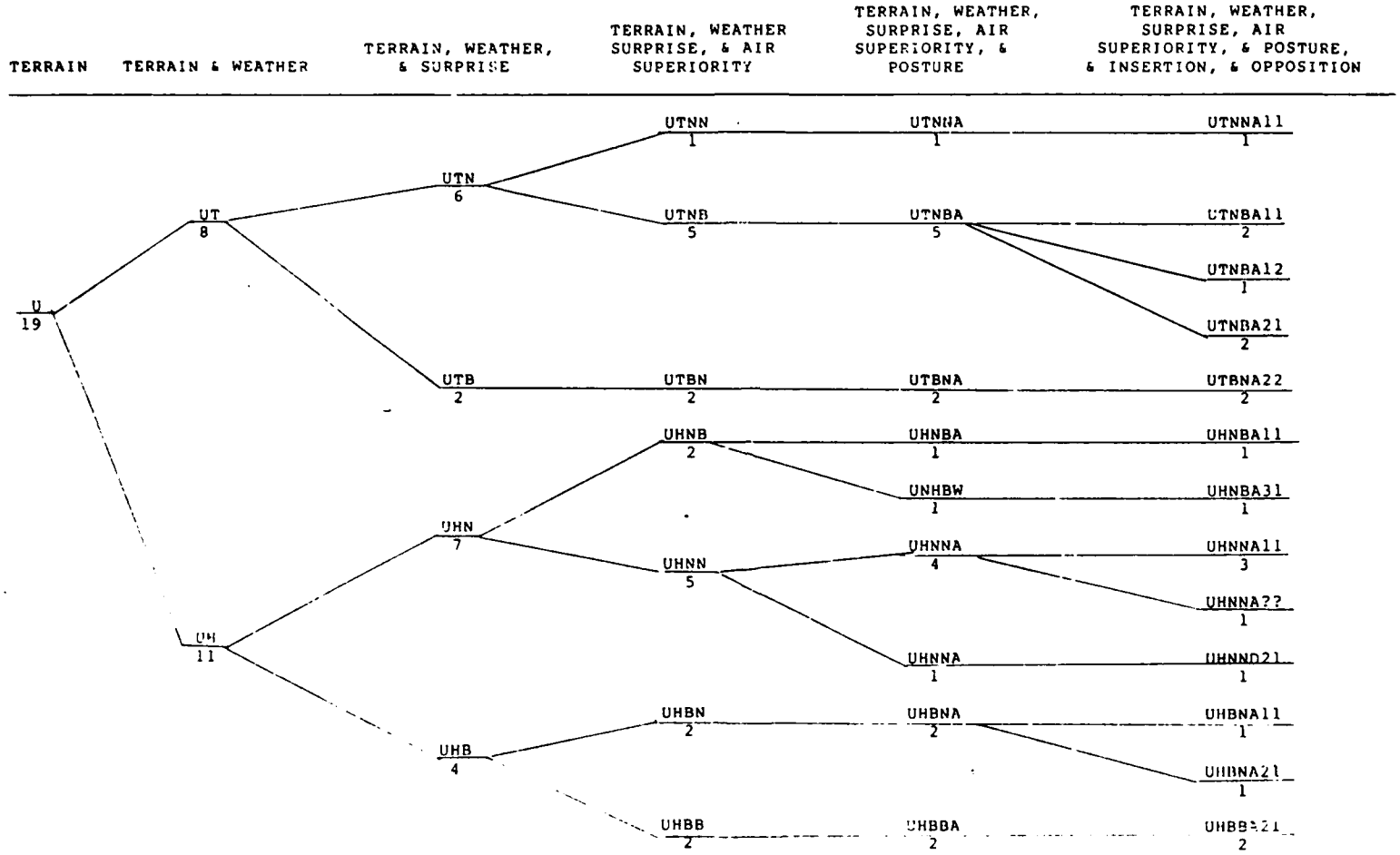
IMPROVEMENT IN THE DATA BASE

The 73 engagement sample is large enough to draw some useful inferences about mean casualty rates and wounded to killed ratios. The cells of the terrain-weather composite matrix may be large enough to permit drawing inferences about the combined effect of these variables on casualty rates. There are too few engagements, however, to permit combining more than two variables into composite matrices. In order to illustrate this point, Figure 15 shows the successive diminution in cell size as more and more variables are disaggregated. Even at the third level of disaggregation, the cell sizes are too small to be significant.

It would be possible to provide better casualty information if more data were available. The data base can be improved in four ways.

Figure 15

ENGAGEMENTS FOR COMPOSITE MATRICES



1. Use of primary sources would provide more accurate and more differentiated data. The original terms of reference specified secondary sources for the research. This has not really been satisfactory. Only the official reports will provide data by the various categories of interest because authors of secondary sources often aggregate data for simplicity and ease of understanding. (Even primary sources, however, may not provide the desired breakout by categories.)

2. The number of contingency engagements for which there is casualty data, while adequate statistically, is still small compared to the number of minor contingencies which have occurred since 1945. There has been insufficient research on some of these contingencies. Additional work on the minor contingencies is likely to produce good casualty data for a much larger number of contingency engagements.

3. The sample of engagements from extended insurgencies is very small compared to the population of insurgency engagements. This is because research on these was curtailed once their nature was revealed in the analysis. A relatively modest research effort could increase substantially the number of extended insurgency engagements for which there is useable casualty data.

4. The work thus far reveals an opportunity to use the experience of Vietnam to help to project casualties for future minor contingency operations. Organizing the Vietnam War into campaigns, battles, and engagements would make it possible to

obtain a large number of additional engagements for analysis. The US Army experience in Vietnam would be directly relevant to US Army projections. Official records of the Vietnam War are the only source which can provide enough casualty data by personnel categories to provide useful information for personnel planning.

FINDINGS

The analysis of 73 engagements from minor contingencies and extended insurgencies from 1945 to 1985 does not provide definitive casualty rate estimates for planning or modelling. It does provide some useful insights, as follows:

-- A company or battalion-sized unit on a minor contingency operation is likely to experience casualty rates of 35 per thousand per day of combat or less. Casualty rates larger than this are possible, but will be due to catastrophic events rather than "normal" combat.

-- Between three and four personnel will be wounded for each person killed in action.

-- Lower than average total battle casualty rates will be experienced in hot climates, rugged terrain, or both.

-- Achieving surprise will reduce casualty rates by half; being surprised will increase casualty rates by a factor of three.

-- Higher than average casualty rates can be expected when an initial entry by helicopter or parachute assault is opposed.

-- Captured and missing in action personnel are not a major factor in this kind of operation, provided unit discipline

is good and a mass capitulation does not occur.

-- Estimation of expected casualty rates during planning for minor contingency operations can be facilitated by taking into account the expected environmental and operational conditions of the operation, as well as the relative combat effectiveness of the two forces.

END

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